

This listing of claims will replace all prior versions, and listings, of claims in the application:

1 Claim 1 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) performing a constraint-based path determination
5 to a next node selected from a group of nodes
6 consisting of
7 (i) an area border node,
8 (ii) an autonomous system gateway node,
9 (iii) a node that can process one of the at least
10 one network path determination constraint carried
11 by the message which the present node cannot, or
12 will not, evaluate,
13 (iv) a specified loose-hop node, and
14 (v) a node to which constraint processing is
15 delegated,
16 to generate a partial path; and
17 b) forwarding the message carrying the at least one
18 network path determination constraint to an adjacent
19 downstream node on the partial path, or to a delegated
20 node that is able to carry out the path determination.

1 Claim 2 (original): The method of claim 1 wherein the path
2 is a label-switched path.

1 Claim 3 (original): The method of claim 1 wherein the
2 message is a resource reservation protocol PATH message.

1 Claim 4 (original): The method of claim 1 wherein the at
2 least one network path determination constraint includes at

3 least two constraints selected from a group of constraints
4 consisting of:
5 - link type
6 - minimum link bandwidth,
7 - minimum reservable link bandwidth,
8 - maximum current bandwidth reservation,
9 - maximum current bandwidth usage,
10 - link coloring,
11 - link administrative group,
12 - link delay,
13 - link media type,
14 - end-to-end path minimum bandwidth,
15 - end-to-end path maximum number of hops,
16 - end-to-end path minimum priority,
17 - optical link wavelength,
18 - optical link minimum signal to noise ratio,
19 - optical link maximum power dispersion,
20 - optical link transmission power,
21 - optical link receiver sensitivity,
22 - node type,
23 - minimum node throughput,
24 - node quality of service support, and
25 - node queuing type.

1 Claim 5 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) performing a constraint-based path determination
5 to a next node to generate a partial path; and
6 b) forwarding the message carrying the at least one
7 network path determination constraint to an adjacent
8 downstream node on the partial path.

1 Claim 6 (original): A network node comprising:
2 a) a path determination facility for performing a
3 constraint-based path determination to a next node to
4 generate a partial path; and
5 b) a signaling facility for
6 i) receiving a message carrying at least one
7 network path determination constraint, and
8 ii) forwarding the message carrying the at least
9 one network path determination constraint to an
10 adjacent downstream node on the partial path.

1 Claim 7 (original): The method of claim 1 wherein the at
2 least one network path determination constraint includes at
3 least one constraint selected from a group of constraints
4 consisting of:
5 - node type,
6 - minimum node throughput,
7 - node quality of service support, and
8 - node queuing type.

1 Claim 8 (original): The method of claim 1 wherein the at
2 least one network path determination constraint includes a
3 list of at least one explicit node specified to be a part
4 of the path.

1 Claim 9 (original): The method of claim 8 wherein the list
2 of at least one explicit node specified to be a part of the
3 path identifies at least one of a strict-hop node and a
4 loose-hop node.

1 Claim 10 (original): The method of claim 8 wherein the
2 message forwarded to the adjacent downstream node on the
3 partial path includes an updated list, and
4 wherein the node maintains the initial instance
5 of the list, as received.

1 Claim 11 (original): The method of claim 1 wherein each of
2 the at least one network path determination constraint is
3 an executable instruction.

1 Claim 12 (original): The method of claim 11 wherein each
2 executable instruction includes:
3 - information about a first operand;
4 - information about a second operand; and
5 - an operation code.

1 Claim 13 (original): The method of claim 12 wherein the
2 operation code identifies an operation selected from a
3 group of operations consisting of:
4 - bit-wise AND;
5 - bit-wise OR;
6 - bit-wise XOR;
7 - bit-wise equality;
8 - bit-wise inversion;
9 - Boolean AND;
10 - Boolean OR; and
11 - Boolean negation.

1 Claim 14 (original): The method of claim 12 wherein the
2 information about either of the first operand or the second
3 operand is a pointer to a register.

1 Claim 15 (original): The method of claim 14 wherein the
2 register is a register which contains a link attribute.

1 Claim 16 (original): The method of claim 14 wherein the
2 register is a read-only register.

1 Claim 17 (original): The method of claim 1 further
2 comprising:
3 - generating a list which specifies nodes on the
4 partial path as strict hop nodes; and
5 - forwarding the list to an adjacent downstream node
6 on the partial path.

1 Claim 18 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) determining whether the node is a tail-end node, a
5 head-end node, or an intermediate node of the path;
6 b) if it is determined that the node is a tail-end
7 node and each of the at least one network path
8 determination constraint has been satisfied, then
9 signaling back to an upstream node of the path that
10 the path is OK;
11 c) if it is determined that the node is one of a
12 head-end node and an intermediate node, then
13 i) determining whether (a) a strict-hop node is
14 specified as a next node of an explicit path
15 constraint, (b) a loose-hop node is specified as
16 a next node of an explicit path constraint, or
17 (c) no node is specified as an explicit path
18 constraint,

19 ii) if a strict-hop node is specified as a next
20 node of an explicit path constraint, then
21 A) applying each of the at least one
22 network path determination constraint to an
23 appropriate one of a link between the node
24 and the strict-hop node, the strict-hop
25 node, and the partial path defined,
26 B) if each of the at least one constraint
27 is satisfied, then forwarding a message
28 carrying the at least one network path
29 determination constraint to the strict-hop
30 node, and
31 C) if any one of the at least one
32 constraint was not satisfied, then signaling
33 a path error back to an upstream node,
34 iii) if one of (a) a loose hop node is specified
35 as a next node of an explicit path constraint or
36 (b) no node is specified as an explicit path
37 constraint, then
38 A) performing a constraint-based path
39 determination to a next node selected from a
40 group of nodes consisting of
41 (1) an area border node,
42 (2) an autonomous system gateway node,
43 (3) a node that can process one of the
44 at least one network path determination
45 constraint carried by the message which
46 the present node cannot, or is
47 unwilling to, evaluate,
48 (4) a specified loose-hop node, and
49 (5) a node to which constraint
50 processing is delegated,

51 to generate a partial path, and
52 B) forwarding the message carrying the at
53 least one network path determination
54 constraint to an adjacent downstream
55 node on the partial path.

1 Claim 19 (original): The method of claim 18 wherein the
2 upstream node is the head-end node.

1 Claim 20 (original): A machine-readable medium having
2 stored thereon at least one network path determination
3 constraint as an executable instruction, each executable
4 instruction comprising:
5 - information concerning a first operand;
6 - information concerning a second operand; and
7 - an operation code.

1 Claim 21 (original): The machine-readable medium of claim
2 20 wherein the operation code denotes an operation selected
3 from a group of operations consisting of:
4 - bit-wise AND;
5 - bit-wise OR;
6 - bit-wise XOR;
7 - bit-wise equality;
8 - bit-wise inversion;
9 - Boolean AND;
10 - Boolean OR; and
11 - Boolean negation.

1 Claim 22 (original): The machine-readable medium of claim
2 20 wherein the information concerning either of the first
3 operand or the second operand is a pointer to a register.

1 Claim 23 (original): The machine-readable medium of claim
2 22 wherein the register is a register that contains a link
3 attribute.

1 Claim 24 (original): The machine-readable medium of claim
2 22 wherein the link attribute is selected from a group of
3 link attributes consisting of:

- 4 - link type;
- 5 - maximum link bandwidth;
- 6 - maximum reservable link bandwidth;
- 7 - current bandwidth reservation;
- 8 - current bandwidth usage;
- 9 - link coloring;
- 10 - link administrative group;
- 11 - link delay;
- 12 - link media type;
- 13 - optical link wavelength;
- 14 - optical link minimum signal to noise ratio;
- 15 - optical link maximum power dispersion;
- 16 - optical link transmission power; and
- 17 - optical link receiver sensitivity.

1 Claim 25 (original): The machine-readable medium of claim
2 22 wherein the register is a register that contains a node
3 attribute.

1 Claim 26 (original): The machine-readable medium of claim
2 25 wherein the node attribute is selected from a group of
3 node attributes consisting of:

- 4 - node type;
- 5 - minimum node throughput;

- 6 - node quality of service support; and
- 7 - node queuing type.

1 Claim 27 (original): The machine-readable medium of claim
2 20 having further stored thereon at least one network path
3 determination constraint as a list of at least one explicit
4 node that is specified to be a part of the network path.

1 Claim 28 (original): The machine-readable medium of claim
2 27 wherein the at least one explicit node is one of a
3 loose-hop node and a strict-hop node.

1 Claim 29 (original): A network node comprising:
2 a) a plurality of registers including attribute
3 registers, the attribute registers storing attributes
4 of links in the network; and
5 b) a machine-readable medium having stored thereon
6 at least one network path determination constraint as
7 an executable instruction, each executable instruction
8 including
9 i) a first operand pointer,
10 ii) a second operand pointer, and
11 iii) an operation code,
12 wherein at least one of the first and second
13 operand pointers points to one of the attribute
14 registers.

1 Claim 30 (original): The network node of claim 29 wherein
2 the plurality of registers further includes general purpose
3 registers,
4 wherein each of the attribute registers is a
5 read-only register, and

6 wherein each of the general purpose registers is
7 read/write register.

1 Claim 31 (original): The network node of claim 29 wherein
2 the machine-readable medium also has stored thereon at
3 least one network path determination constraint as a list
4 of at least one explicit node that is specified to be a
5 part of the network path.

1 Claim 32 (original): The network node of claim 31 wherein
2 the at least one explicitly specified node is one of a
3 loose-hop node and a strict-hop node.

1 Claim 33 (original): The network node of claim 29 wherein
2 the plurality of registers further include accumulation
3 registers storing cumulative attributes of a path.

1 Claim 34 (original): A machine-readable medium having
2 stored thereon:
3 a) an executable instruction encoding at least one
4 network path determination constraint; and
5 b) a list of at least one explicit node specified to
6 be a part of the path.

1 Claim 35 (original): The machine-readable medium of claim
2 34 wherein the executable instruction includes:
3 - information concerning a first operand;
4 - information concerning a second operand; and
5 - an operation code.

1 Claim 36 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) if the tail-end node of the path is in a part of
5 the network, the topology of which is not known by the
6 node, then performing a constraint-based path
7 determination to a next node selected from a group of
8 nodes consisting of
9 (i) an area border node, and
10 (ii) an autonomous system gateway node,
11 to generate a partial path; and
12 b) forwarding the message carrying the at least one
13 network path determination constraint to an adjacent
14 downstream node on the partial path.

1 Claim 37 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) if a next node specified in a list of explicit
5 nodes is a loose-hop node, then performing a
6 constraint-based path determination to the next
7 loose-hop node to generate a partial path; and
8 b) forwarding the message carrying the at least one
9 network path determination constraint to an adjacent
10 downstream node on the partial path.

1 Claim 38 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) if the node cannot process any one of the at least
5 one network path determination constraint, performing
6 a constraint-based path determination to a node that

7 can process that one of the at least one network path
8 determination constraint, to generate a partial path;
9 and
10 b) forwarding the message carrying the at least one
11 network path determination constraint to an adjacent
12 downstream node on the partial path.

1 Claim 39 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) if constraint processing has been delegated to
5 another network element, performing a constraint-based
6 path determination to the other network element to
7 which constraint processing has been delegated to
8 generate a partial path; and
9 b) forwarding the message carrying the at least one
10 network path determination constraint to an adjacent
11 downstream node on the partial path.

1 Claim 40 (currently amended): ~~In a~~ The network node of
2 claim 6, a routing facility, the routing facility further
3 comprising:
4 ca) a process for generating a traffic engineering
5 database; and
6 db) a traffic engineering database generated by the
7 processing for generating,
8 ~~e) a signaling facility; and~~
9 ~~d) a constraint based path determination facility~~
10 ~~for~~
11 wherein the path determination facility is further
12 adapted to determine ~~determining~~ at least a part of
13 a path based on

14 i) contents of the traffic engineering
15 database, and
16 ii) at least one path constraint received from
17 the signaling facility,
18 wherein, if the path determination ~~routing~~
19 facility cannot determine a complete constraint-based
20 path to a specified tail-end node, then the
21 ~~constraint-based~~ path determination facility performs a
22 constraint-based path determination to a next node
23 selected from a group of nodes consisting of
24 - an area border node,
25 - an autonomous system gateway node,
26 - a node that can process one of the at least
27 one network path determination constraint
28 carried by the message which cannot be
29 evaluated by the present node,
30 - a specified loose-hop node, and
31 - a node to which constraint processing is
32 delegated,
33 to generate a partial path, and
34 the signaling facility forwards a message carrying the at
35 least one path constraint to an adjacent downstream node
36 on the partial path.

1 Claim 41 (original): The routing facility of claim 40
2 wherein the path is a label-switched path.

1 Claim 42 (original): A method of establishing a path from
2 a first node to a second node in a network, the method

3 comprising:
4 a) computing a first portion of the path from the
5 first node to a first intermediary node, subject to
6 a set of at least one constraint;
7 b) generating a message that includes information
8 relating to the set of constraints; and
9 c) transmitting the message to a down-stream node
10 on the first portion of the path.

1 Claim 43 (original): The method according to claim 42,
2 wherein the path is a label-switched path.

1 Claim 44 (original): The method according to claim 42,
2 wherein the act of generating includes generating a message
3 that includes instructions for determining additional
4 portions of the path in which the set of at least one
5 constraint is met.

1 Claim 45 (original): The method according to claim 42,
2 wherein the act of generating includes generating a message
3 that includes a set of instructions for determining a
4 second portion of the path from the first intermediary node
5 to the second node subject to the set of at least one
6 constraint.

1 Claim 46 (original): The method according to claim 42,
2 wherein the act of generating includes generating a message
3 that includes a set of instructions for determining a
4 second portion of the path from the first intermediary node

5 to a second intermediary node subject to the set of at
6 least one constraint.

1 Claim 47 (original): A method of establishing a path from
2 a first node to a second node in a network, the method
3 comprising:
4 a) receiving, at a first intermediary node, a
5 message including information defining a first
6 portion of the path and information relating to a
7 set of at least one constraint;
8 b) computing, at the first intermediary node, a
9 second portion of the path subject to the
10 information relating to the set of at least one
11 constraint.

1 Claim 48 (original): The method according to claim 47,
2 wherein the act of computing is performed if the first
3 intermediary node is the last node in the first portion of
4 the path.

1 Claim 49 (original): The method according to claim 47,
2 wherein the act of computing includes computing additional
3 portions of the path subject to the set of at least one
4 constraint.

1 Claim 50 (original): The method according to claim 47,
2 wherein the act of computing includes computing a second
3 portion of the path from the first intermediary node to the
4 second node.

1 Claim 51 (original): The method according to claim 47,
2 wherein the act of computing includes computing a second
3 portion of the path from the first intermediary node to a
4 second intermediary node.

1 Claim 52 (original): A method of establishing a path from
2 a first node to a second node in a network, the method
3 comprising:
4 a) receiving, at a first intermediary node, a
5 message including information defining a first
6 portion of the path and information relating to a
7 set of at least one constraint; and
8 b) if the first intermediary node is not the last
9 node in the first portion of the path, transmitting,
10 from the first intermediary node to the next
11 downstream node in the first portion of the path, at
12 least a part of the received message.

1 Claim 53 (currently amended): The A method of claim 5,
2 wherein the node is an intermediary node, and wherein
3 ~~establishing a path from a first node to a second node in a~~
4 ~~network, the method comprising:~~
5 ~~a) receiving, at a first intermediary node in a~~
6 ~~first portion of the path, a message that includes~~
7 ~~information relating to a set of at least one~~
8 ~~constraint; and~~
9 b) the act of performing a constraint-based path
10 determination includes determining whether a link
11 from the first intermediary node to the next node

12 specified in the first portion of the path satisfies
13 the set of at least one constraint.

1 Claim 54 (original): The method of claim 53, further
2 comprising:

3 c) if the link from the first intermediary node to
4 the next node specified in the first portion of the
5 path is determined to satisfy the set of at least
6 one constraint, then transmitting the received
7 message to the next node.

1 Claim 55 (original): The method of claim 53, further
2 comprising

3 c) if the link from the first intermediary node to
4 the next node specified in the first portion of the
5 path is determined not to satisfy the set of at
6 least one constraint, then transmitting an error
7 message back to the source node.

1 Claim 56 (original): A method of processing a message that
2 includes information defining a first portion of a path
3 from a first node to a second node in a network and
4 information relating to a set of at least one constraint
5 for establishing the path, the method comprising:

6 a) determining, at a receiving node that receives
7 the message, whether the receiving node comprises
8 the second node or an intermediary node in the path;
9 b) if the receiving node is determined to be the
10 second node, then generating, at the receiving node,
11 a message to be sent to the first node; and

12 c) if the receiving node is determined to be an
13 intermediary node in the path, then:
14 i) determining whether the message specifies at
15 least one of a strict-hop node and a loose-hop
16 node;
17 ii) if the message specifies a strict-hop node,
18 then forwarding the message to the strict-hop
19 node on a link in which the set of constraints
20 are met;
21 iii) if the message does not specify a strict-
22 hop node, but specifies a loose-hop node, then
23 computing paths from the receiving node to the
24 loose-hop node subject to the set of at least one
25 constraint and selecting one of the computed
26 paths on which to transmit the message; and
27 iv) if the message does not specify either a
28 strict-hop node or a loose-hop node, then
29 computing paths from the receiving node to either
30 the second node or an intermediary node subject
31 to the set of at least one constraint and
32 selecting one of the computed paths on which to
33 transmit the message.

1 Claim 57 (currently amended): The machine-readable
2 medium of claim 35 wherein the ~~An instruction embodied~~
3 ~~on a medium used to determine whether a path through a~~
4 ~~network to a destination node meets a constraint, the~~
5 ~~instruction comprising: a) a first operand specifying~~
6 specifies a memory location in which a value for an
7 attribute of a network node or link is stored, and the +

8 ~~b) a second operand representing~~ represents a constraint
9 value for the attribute, and further comprising:
10 c) a code specifying an operation to be performed
11 on the first operand and second operand; and
12 d) a result portion specifying a memory location in
13 which a result of the operation performed on the
14 first operand and second operand is stored.
15

Claims 58 and 59 (canceled)

1 Claim 60 (currently amended): The network node of claim
2 29, wherein the machine-readable medium further stores
3 thereon a ~~A table embodied on a medium, the table~~
4 including comprising:
5 ia) a first entry representing a first
6 attribute of a node or link connected to the
7 node, ~~+~~
8 iib) a second entry representing an
9 accumulated value for a second attribute of a
10 node or link connected to the node, ~~+~~ and
11 iiie) a third entry storing a result of a
12 specified operation performed on one of the
13 first entry and the second entry.

1 Claim 61 (currently amended): The network node of claim
2 29, wherein the machine-readable medium further stores
3 thereon a memory data structure including ~~A node in a~~
4 ~~network, the node comprising:~~

5 ia) a first portion ~~of memory~~ storing
6 attributes of nodes or links in the network, +
7 iib) a second portion ~~of memory~~ storing
8 network-path constraints, and +
9 iiie) a third portion ~~of memory~~ storing
10 instructions for performing operations on the
11 stored attributes and the stored constraints;
12 and further comprising:
13 cd) a processor for executing the instructions
14 stored in the third portion of memory and computing
15 a path in the network based on results of the
16 executed instructions.

1 Claim 62 (original): A node of a network, the node
2 comprising:
3 a) an input for accepting a message carrying at
4 least one network path determination constraint;
5 b) a path determination facility for, if the node
6 cannot process any one of the at least one network
7 path determination constraint, performing a
8 constraint-based path determination to a node that
9 can process that one of the at least one network
10 path determination constraint, to generate a partial
11 path; and
12 c) a signaling facility for forwarding the message
13 carrying the at least one network path determination
14 constraint to an adjacent downstream node on the
15 partial path.

1 Claim 63 (currently amended): ~~The A node of a network, the~~
2 ~~node of claim 6 wherein comprising:~~

- 3 ~~a) an input for accepting a message carrying at~~
4 ~~least one network path determination constraint;~~
5 ~~b) a path determination facility for, if constraint~~
6 ~~processing has been delegated to another network~~
7 ~~element, then the path determination facility~~
8 ~~further performs performing a constraint-based path~~
9 ~~determination to the other network element to which~~
10 ~~constraint processing has been delegated to generate~~
11 ~~a partial path; and~~
12 ~~c) a signaling facility for forwarding the message~~
13 ~~carrying the at least one network path determination~~
14 ~~constraint to an adjacent downstream node on the~~
15 ~~partial path.~~

1 Claim 64 (original): A network node comprising:

- 2 a) a path determination facility for determining a
3 first portion of a path from the network node to a
4 first intermediary node, subject to a set of at
5 least one constraint; and
6 b) a signaling facility for
7 i) generating a message that includes
8 information relating to the set of at least one
9 constraint, and
10 ii) transmitting the message to a downstream
11 node on the first portion of the path.

1 Claim 65 (original): A network node in a path between a
2 first node and a second node, the network node comprising:
3 a) an input for receiving a message including
4 information defining a first portion of the path and
5 information relating to a set of at least one
6 constraint; and
7 b) a signaling facility for, if the network node is
8 not the last node in the first portion of the path,
9 transmitting to the next downstream node in the
10 first portion of the path, at least a part of the
11 received message.

1 Claim 66 (original): A network node in a first portion of
2 a path between a first node and a second node, the network
3 node comprising:
4 a) receiving a message that includes information
5 relating to a set of at least one constraint; and
6 b) means for determining whether a link from the
7 network node to a next node specified in the first
8 portion of the path satisfies the set of at least
9 one constraint.

1 Claim 67 (original): The network node of claim 66 further
2 comprising:
3 c) a signaling facility for, if the link from the
4 network node to the next node specified in the first
5 portion of the path is determined to satisfy the set
6 of at least one constraint, transmitting the
7 received message to the next node.

1 Claim 68 (original): The network node of claim 66 further
2 comprising
3 c) a signaling facility for, if the link from the
4 network node to the next node specified in the first
5 portion of the path is determined not to satisfy the
6 set of at least one constraint, then transmitting an
7 error message back to the first node.

1 Claim 69 (original): A network node comprising:
2 a) an input for accepting a message that includes
3 information defining a first portion of a path from a
4 first node to a second node in a network and
5 information relating to a set of at least one
6 constraint for establishing the path;
7 b) means for determining whether the network node
8 comprises the second node or an intermediary node in
9 the path; and
10 c) a signaling facility for
11 i) if the network node is determined to be the
12 second node, generating a message to be sent to
13 the first node, and
14 ii) if the network node is determined to be an
15 intermediary node in the path,
16 A) determining whether the message
17 specifies at least one of a strict-hop node
18 and a loose-hop node;
19 B) if the message specifies a strict-hop
20 node, forwarding the message to the
21 strict-hop node on a link in which the set
22 of constraints are met;

23 C) if the message does not specify a
24 strict-hop node, but specifies a loose-hop
25 node, computing paths from the receiving
26 node to the loose-hop node subject to the
27 set of at least one constraint and selecting
28 one of the computed paths on which to
29 transmit the message; and
30 D) if the message does not specify either a
31 strict-hop node or a loose-hop node, then
32 computing paths from the receiving node to
33 either the second node or an intermediary
34 node subject to the set of at least one
35 constraint and selecting one of the computed
36 paths on which to transmit the message.

1 Claim 70 (original): A method for processing, by a node of
2 a network, a message carrying at least one network path
3 determination constraint, the method comprising:
4 a) determining whether to delegate constraint
5 processing to another device; and
6 b) if it has been determined that constraint
7 processing has been delegated to another network
8 element, forwarding the message carrying the at least
9 one network path determination constraint to the other
10 device.